PROCESS FOR THE CONVERSION OF CELLULOSE ACETATE WASTE FIBERS INTO A SUITABLE FORM FOR PAPER PRODUCTION AND THE RESULTANT PAPER PRODUCTS

Technical Field and Background of the Invention

[0001] This application is based on and claims priority from Provisional Application No. 60/465,743, filed April 25, 2003.

[0002] This invention relates to a process for the conversion of cellulose acetate waste fibers into a suitable form for paper production, and resultant paper products.

[0003] The majority of cigarettes manufactured today have a filter composed of cellulose acetate fibers. Cigarettes having a cellulose acetate filter are typically prepared by using a continuous length of cellulose acetate fiber to prepare a long filter rod, then cutting the long filter rod into a multiplicity of shore lengths, or plugs, to form individual cigarette filters. The cigarette is then prepared by attaching these filters to an elongate column of tobacco contained in cigarette paper.

[0004] The above described process for preparation of cigarettes results in three waste streams of cellulose acetate fiber. The first waste stream results from the manufacture of the continuous cellulose acetate filament which is used in filter rod manufacture. Filament waste typically comes from off-specification filament bands, damaged gaylords or aged inventory. Although these filaments can be redissolved and recycled back into an acetate dope filament production process, this recycling method is sometimes undesirable.

[0005] The second waste stream results from preparing the cellulose acetate fiber into filter rods and individual filters and is often referred to in the tobacco industry as "plug room waste". Plug room waste typically comes from off-specification filters and filters used for quality control. In addition to the cellulose acetate fiber, this material typically contains plasticizer, paper and other materials.

[0006] The third waste stream results from improperly manufactured cigarettes and is often referred to in the tobacco industry as "rip room waste". In addition to the cellulose acetate fiber, this material typically contains tobacco, plasticizer, paper and other materials.

[0007] These waste materials are currently being land-filled. However, because of the increasing cost of disposal and decreasing landfill space, cigarette filter tow suppliers and cigarette manufacturers are looking for alternatives to disposal.

[0008] The addition of cellulose acetate fibers to paper is well known in the art. U.S. Pat. No. 4,040,856 to Litzinger discloses an extrusion process for making cellulose acetate fibers for papermaking. The fibers are suitable for direct addition to conventional papermaking methods. Two related patents, U.S. Pat. Nos. 4,047,862 and 4,460,647 to Keith disclose a cellulose acetate fiber for use in paper applications which is produced by precipitation of cellulose acetate from a dope under high shear conditions. In U.S. Pat. No. 5,213,883 to Mehta, a decorative sheet is disclosed having 1 to 20 weight percent cellulose acetate fibers added to cellulose pulp and TiO_2. However, the amount of cellulose acetate fibers that can be added to paper without substantial linting during the printing process is typically below 10 percent by weight, thus limiting the extent of the addition of this artificial fiber to the paper. With binders the cellulose acetate fiber content may be doubled, however this technology is not desirous because of the expense and difficulty in processing binders.

[0009] Thus, there is a need in the art to obtain a paper product with enhanced bonding to cellulosic fibers therefore allowing the addition of greater quantities of cellulose acetate fibers without the problems associated with linting and using binders, such as is disclosed in two related patents, U.S. Pat. Nos. 5,573,640 and 5,662,773 to Frederick. These patents disclose a process for producing a cellulose acetate fiber which has been treated with an aqueous base until at least 5% of the acetyl groups on the said cellulose

acetate has been hydrolyzed for use in paper applications and the resultant paper produced.

Summary of the Invention

[0010] Therefore, it is an object of the invention to provide a process for treating waste cellulose acetate into a form suitable for incorporation into paper products.

[0011] It is another object of the invention to provide a process for treating waste cellulose acetate that makes use of several types of typical cellulose acetate waste that is currently disposed of by landfilling.

[0012] It is another object of the invention to provide paper products that contain specified percentages of processed waste cellulose acetate.

[0013] These and other objects of the present invention are achieved in the preferred embodiments disclosed below by providing a process for producing paper with mechanically processed waste cellulose acetate fiber, comprising the steps of providing a raw material in the form of waste long staple or continuous filament cellulose acetate fibers, and mechanically shredding the waste cellulose acetate to a fiber length of less than about 14 mm. The shredded waste cellulose acetate is mixed with cellulose to form a slurry, and paper is made from the slurry.

[0014] According to one preferred embodiment of the invention, the waste cellulose acetate fiber contains substantial crimp.

[0015] According to another preferred embodiment of the invention, the crimp is produced by mechanical interfiber plasticizer bond separation due to shredding.

[0016] According to yet another preferred embodiment of the invention, the process includes the step of repulping the mechanically shredded cellulose acetate and cellulose with water.

[0017] According to yet another preferred embodiment of the invention, the step of repulping is conducted with periodic or continuous high shear agitation.

[0018] According to yet another preferred embodiment of the invention, the process further comprises the step of confricating or mechanically refining the aqueous mixture of cellulose acetate and cellulose.

[0019] According to yet another preferred embodiment of the invention, the process comprises the step of blending the aqueous mixture of cellulose acetate and cellulose with paper manufacturing fillers and sizes.

[0020] According to yet another preferred embodiment of the invention, the paper comprises between about 90 and about 99% by weight of cellulose and between about 1 and about 10% percent by weight of cellulose acetate fiber having a length of less than about 14 mm.

[0021] According to yet another preferred embodiment of the invention, the process includes the steps of forming the paper product into a continuous paper web with a weight of about 15-40 grams/meter^2, and fabricating the paper web into cigarette filter tips.

[0022] According to yet another preferred embodiment of the invention, the process includes the steps of forming the paper product into a continuous paper web weighing 200-800 grams/meter^2, and fabricating the paper web into absorbent paper products selected from the group consisting of feminine hygiene articles, adult incontinent diapers and infant diapers.

[0023] Other preferred embodiments of the invention comprise paper products formed according to the process, including cigarette filter tips, feminine hygiene articles, adult incontinent diapers and infant diapers.

Description of the Preferred Embodiment and Best Mode

[0024] The paper products produced from cellulose acetate fibers in accordance with to the invention benefit from reduced bulk or more open sheet porosity, with usage levels typically below 10% of the fiber furnish.

[0025] Waste cellulose acetate fibers processed according to the invention are shredded to cut the very long continuous filament fibers down to a length usable in paper manufacture. A cutting/shredding device is utilized which consists of a high speed rotary cutter head which processes the waste cellulose acetate fibers against a stationary cutter blade. A screen in the rotary cutter retains the waste cellulose acetate fibers until the desired reduction in fiber length is achieved. The screen in the rotary cutter will typically contain openings of approximately 10mm or less. Multiple cutters or a single cutter with a screen retention basket can be used. The fibers produced from the cutting/shredding process preferably have an average length in the range of 0.1 to 14 mm. The fibers have a denier in the range of 1-30 grams per 9000 meters and contain substantial crimp in the range of 1 to 20 crimps per centimeter resulting from crimp inserted during initial manufacture of the cellulose acetate, produced by mechanical interfiber plasticizer bonding, and resulting from impact on the fibers during shredding.

[0026] Waste cellulose acetate fibers altered in this manner are suitable for use in various paper products. The paper of the present invention is produced by a specific process. This process is comprised of the steps of forming a slurry of cellulose and mechanically altered waste cellulose acetate fibers, and confricating the slurry. The confricated slurry is diluted and then blended with paper manufacturing fillers and sizes. A paper is then prepared from the diluted confricated slurry. The paper is dewatered and dried.

[0027] The cellulose fiber used to prepare the paper of this invention is conventional paper making cellulose fiber obtained from wood, cotton, hemp, bagasse, straw, flax and

other plant sources. Both hardwood and softwood may be used. The paper products produced from these fibers with the addition of cellulose acetate as described above benefit from reduced bulk and more open sheet porosity. The cellulose acetate is added at levels typically below 10% of the fiber furnish.

[0028] In other paper product applications, the waste cellulose acetate fiber can be used to enhance product performance. One specific product is cigarette filter tips. At least 10% of the world's cigarette filter tips are manufactured using continuous paper in bobbin form which contains approximately 25 grams/meter^2 of essentially 100% cellulose fibers. Addition of 1-90% waste cellulose acetate fiber to this existing type paper filter will provide enhanced porosity, reduced yellowing, selective smoke stream component filtration, reduced wet collapse and improved cigarette butt environmental dispersion for cigarette filter tips manufactured in this manner.

[0029] Waste cellulose acetate fibers can also be used as a binder fiber for absorbent products. The addition of 1-90% waste cellulose acetate fiber into fluff pulp during manufacture of commercial 750 grams/meter^2 rolls will allow the fluff pulp rolls to contain the acetate fibers prior to use for the manufacture of absorbent products. Absorbent products, defined as feminine hygiene, adult incontinent and baby diapers, can then be manufactured from this fluff pulp and waste cellulose acetate blend. During manufacture, the continuous web of fluff pulp and waste cellulose acetate blend is hammer milled and pneumatically blended with super absorbent polymer. Addition of 5-15% plasticizer to this mixture will cause the acetate to become a binder fiber for the absorbent pad upon drying.

[0030] The following example sets forth one embodiment of the method by which the formulation of the present invention can be produced.

Example 1

[0031] Waste cellulose acetate fibers (filter rods) were shredded using a high speed rotary cutter which included a screen retention basket with openings (holes) of 0.375 inch diameter. The fibers produced from the cutting/shredding process contained substantial crimp. The average length of the fibers was approximately 7mm. The fibers had a denier of 3 grams per 9,000 meters.

[0032] Papers containing the mechanically altered plug room waste fibers were produced using lab-scale Canadian Standard Handsheet equipment owned by Herty Foundation located in Savannah, GA. Batches with a furnish ratio of Hardwood, %Astracel = 50% of wood, Softwood, % Albacel = 50% of wood were prepared, confricated and papered out. The processed cellulose acetate waste fibers were added to the furnish prior to confrication a various desired levels. Handsheets with the various levels of processed waste cellulose acetate were prepared for physical property comparison. Test results follow:

Table No. 1.

Processed Waste Fiber Impact
on Properties of 108 grams/meter^2 Unfilled Sheet

Table 1: CDAP Impact on 108 gsm Unfilled Sheet Properties

Hardwood, %Astracel = 50% of wood
Softwood, % Albacel = 50% of wood

CDAP = plugroom waste ground to ~ 7mm which contains ~7% triacetin

CDAP	Caliper	Density	Porosity Gurley	Tensile
	mils	g/cm3	sec/100cc	kN/m
0	6.1	0.7	43.9	10.2
5	7.5	0.6	30.3	9.4
10	8.5	0.52	13.2	8.5
25	10.8	0.4	2.8	6.3
60	15.5	0.19	0	1.2

CDAP	Caliper Increase %
0	0
1	6
2	11
3	16
4	19
5	23
6	27
7	30
8	33
9	36
10	39

Table No. 2
Sheet Caliper vs. % Processed Waste Fiber

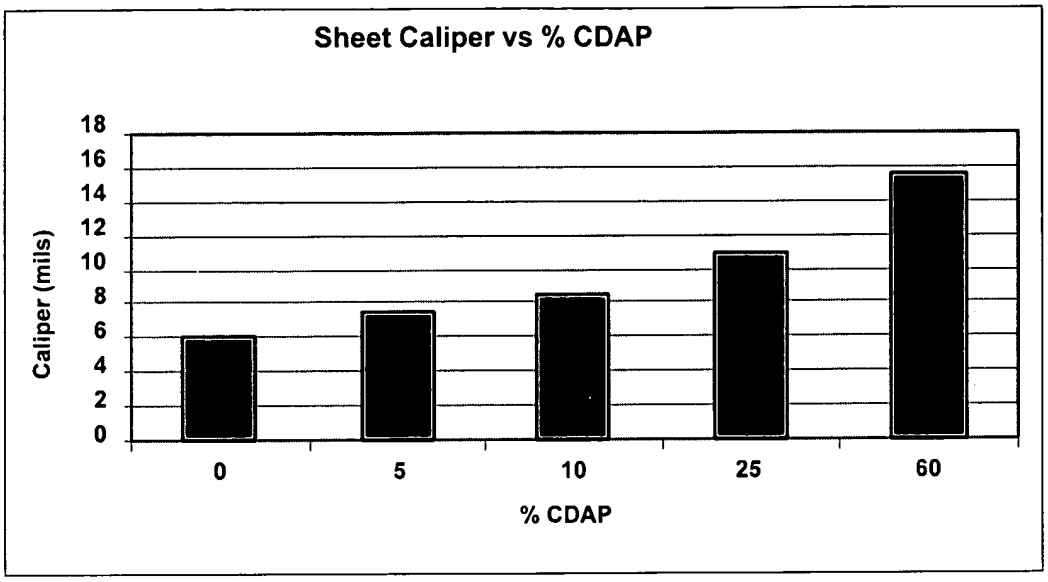


Table No. 3
Density vs. % Processed Waste Fiber

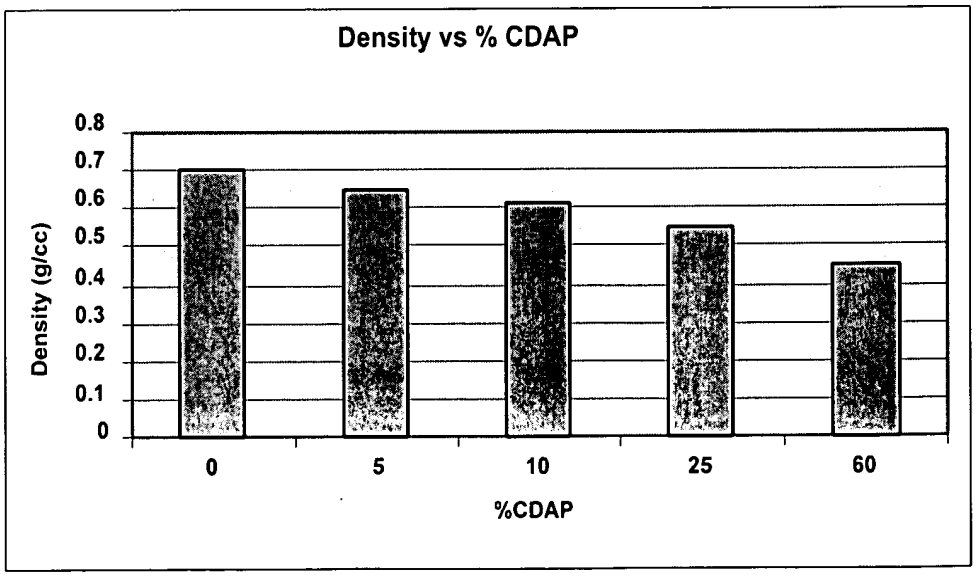


Table No. 4
Tensile vs. % Processed Waste Fiber

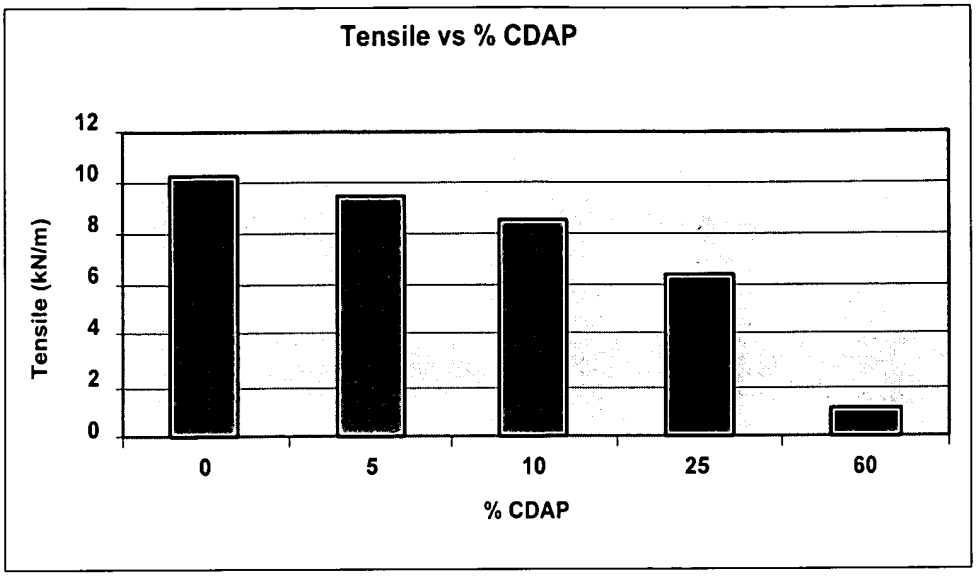


Table No. 5
Gurley Porosity vs. % Processed Waste Fiber

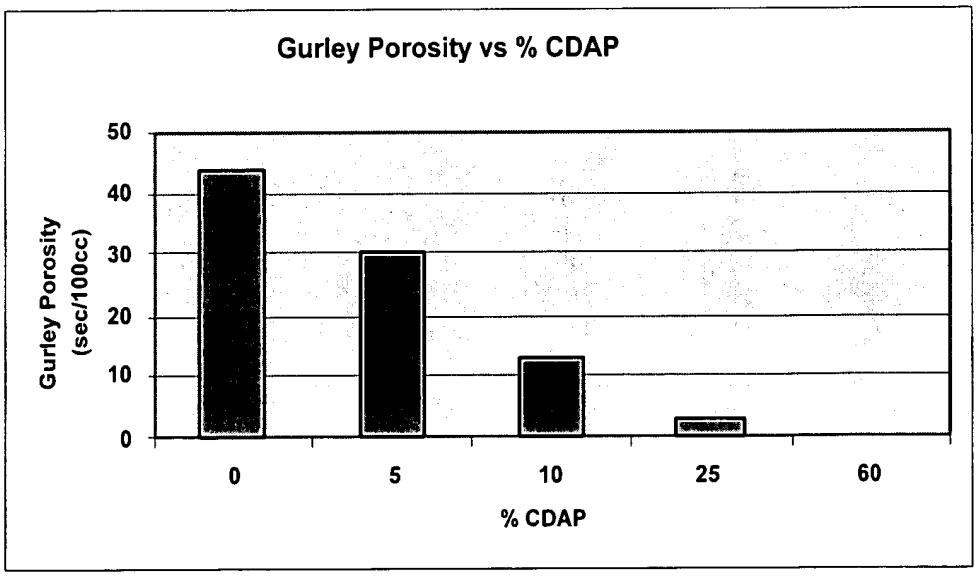
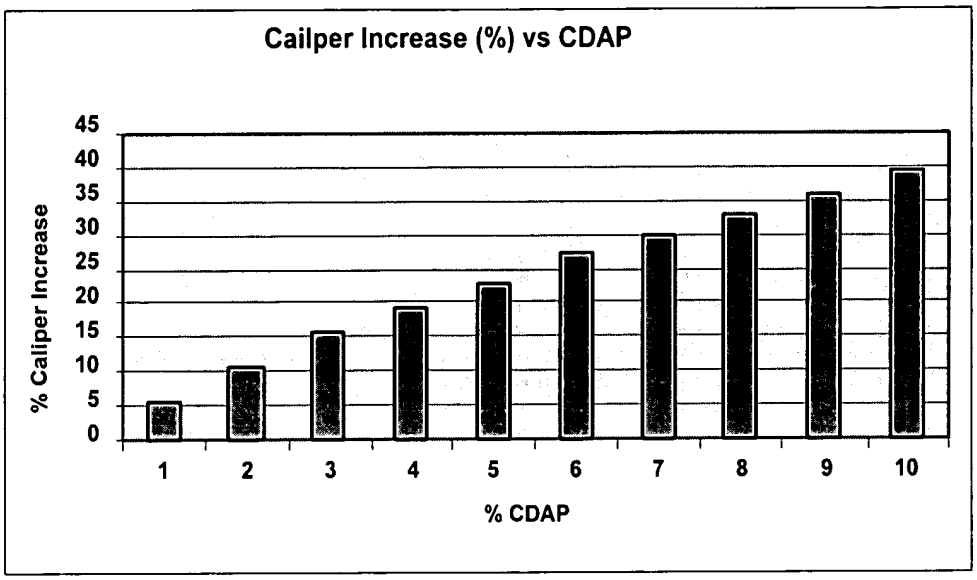


Table No. 6
% Caliper Increase vs. Processed Waste Fiber



[0033] A process for converting cellulose acetate into processed waste fibers in suitable form for paper production and the resulting paper product is described above. Various details of the invention may be changed without departing from its scope. Furthermore, the foregoing description of the preferred embodiment of the invention and the best mode for practicing the invention are provided for the purpose of illustration only and not for the purpose of limitation--the invention being defined by the claims.